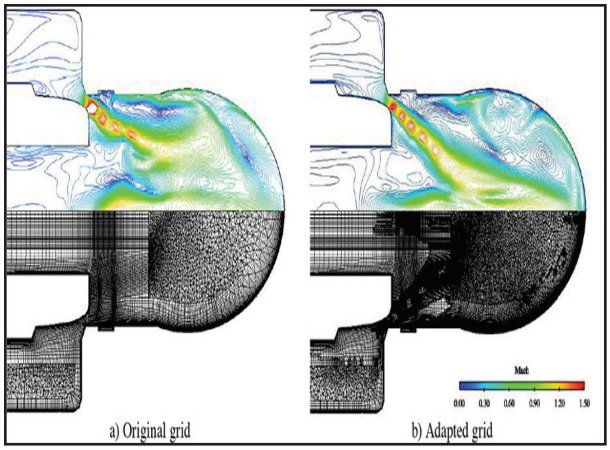
AFRL IMPROVES ACCURACY OF COMPUTATIONAL FLUID DYNAMICS CALCULATIONS



AFRL designers can maximize air vehicle performance and minimize cost when they know how air flows over an air vehicle concept. AFRL developed a tool that improves the accuracy of the computational fluid dynamics (CFD) solutions that the laboratory uses to study this type of airflow. This advancement improves AFRL's ability to deliver low-cost, high-value designs to support the warfighter.

As part of a Small Business Innovation Research effort, AFRL worked with Combustion Research and Flow Technology, Inc. (known as CRAFT Tech®), of Pipersville, Pennsylvania, to develop a tool that improves the accuracy of unstructured CFD solver programs. The tool uses the solver's initial solution to determine where scientists should add or remove grid points within the CFD mesh. This capability enables more accurate solutions for problems such as predicting design performance before air vehicle production; this knowledge narrows design options prior to completing an expensive manufacturing process. In addition, scientists can use the same technology to analyze existing air vehicles. This technology also complements existing wind tunnel testing tools that laboratory experts currently use to improve vehicle performance.

CFD computer programs solve mathematical equations to predict what will happen when a fluid (or air) flows around a structure, such as an air vehicle. The CFD mesh is the three-dimensional grid of data points on and around the structure. Equation solutions occur at these grid points. This grid can be (1) structured, a method which uses multiple cubes (or blocks) of regularly spaced points deformed to follow the vehicle geometry; or (2) unstructured, a method in which the field contains irregularly placed points that connect to form various geometric shapes (e.g., tetrahedrons or prisms). The regular pattern of structured grids simplifies the process of solving the mathematical equations to a given level of accuracy; however, this requires an immense amount of time and expertise to lay out a model's optimal block structure, especially when the model is complex.

Because unstructured grids do not have to adhere to the prescribed layout of a structured grid, their creation is much more automated. Thus, scientists can create an unstructured grid for complex vehicle geometry in days or weeks (versus the weeks or months needed for producing a structured grid). Therefore, unstructured methods result in quicker attainment of CFD solutions for complex air vehicle designs. The drawback of both unstructured and structured grids is that the initial placement of grid points is not necessarily the layout scientists need for obtaining an accurate answer. AFRL's new CFD tool helps to overcome this drawback by using the initial CFD solution to determine what grid points scientists should add or remove to improve the final solution's accuracy.

Additional Information

To receive more information about this or other activities in the Air Force Research Laboratory, contact TECH CONNECT, AFRL/XPTC, (800) 203-6451 and you will be directed to the appropriate laboratory expert. (VA-S-06-09)
Air Vehicles/Emerging Technologies